

need to say that, according to the abstract which I have made of the account (probably incomplete) he kept of the arrivals, he caused to be removed from Rodriguez more than 30,000 land-tortoises in less than eighteen months. When we reflect on the small extent of the island, we cannot be surprised that these animals, formerly so common, have entirely disappeared; notwithstanding their fecundity, they could not withstand such means of destruction.

That which we have stated concerning the tortoises must have taken place also with the land-birds. It is evident that the sailors would not abstain from pursuing and killing them. Those species whose undeveloped wings rendered them easy to capture, while the delicacy of their flesh made them sought after, must have been rapidly exterminated. It is therefore unnecessary, in order to account for their extinction, to invoke changes in the biological conditions; the action of man was amply sufficient, and was exerted there without impediment and with more facility than anywhere else. It is still going on in many other parts of the globe; and we can already foresee the period when many wingless birds, large Cetacea, and certain species of seals and otaries will have been annihilated by man.—*Comptes Rendus de l'Académie des Sciences*, May 10, 1875.

*On the Development of the Pteropoda.* By M. H. FOE.

The vitellus of the Pteropoda before fecundation is histologically a simple cell with a deposit of nutritive matter in its interior. This fecundated vitellus is destitute of membrane and nucleus. It is composed of a formative or protoplasmic portion and of a nutritive portion composed of a network of protoplasm, in the meshes of which the nutritive globules occur. In the centre of the formative part there is a star formed by the granules of the protoplasm arranged in diverging straight lines. The rays of this star stretch to the limit of the formative portion; and the nutritive globules arrange themselves in lines.

After the egress of the so-called corpuscle of direction, a nucleus appears in the centre of the star, which is effaced in proportion to the growth of this nucleus. The granules and the globules of the vitellus cease to be in lines. Before each segmentation the nucleus disappears, to be replaced by two molecular stars which originate in its interior. The centre of each of these stars may be regarded as a centre of attraction; and all the vitelline substance obeys this attraction. After segmentation, a nucleus reappears in the middle of each star, and the vitelline substance remains at rest.

The result of segmentation, which differs little from the recognized types of the Gasteropods, is the development of a nutritive portion, composed of three large spheres, and of a formative moiety, of transparent spherules. Afterwards the nutritive cells divide, producing a superficial layer of little cells, which in the end envelop the three large nutritive spheres and constitute the ectoderm. The fourth of the large central spheres, entirely composed of protoplasm, divides completely and causes a thickening of the ectodermic layer. This region corresponds to the lower extremity of the larva. The line of junction of the three nutritive spherules coincides with the oral-

aboral axis of the larva. The ectoderm closes up in the last place at the point of union of the three spheres, a point which may coincide either with the aboral or with the oral pole of the larva. I am in favour of the latter alternative.

The embryonic development of the Gymnosomes forms a transition between that of the Thecosomes, which I have just recapitulated, and that of the Heteropoda, between the formation of the embryonic lamellæ by envelopment and their formation by invagination.

The digestive cavity is formed by a simple differentiation of the mass of nutritive or central cells. From this results a completely closed trilobate cavity. From the median lobe proceeds the digestive tube; from the lateral lobes the nutritive sacs. The cells composing the walls of this cavity descend directly from the nutritive or central cells of the embryo; they are small and numerous round the median cavity; cuneiform, and composed in great part of nutritive substance round the lateral cavities. The median portion lengthens to form the stomach and the intestine. An invagination of the ectoderm, starting from the point where this lamella has closed up, descends to meet the stomach, with which it unites. This invagination represents the mouth and œsophagus; the point of junction the cardia. It represents in front a diverticulum which gives origin to the radula. This development of the digestive tube agrees point by point with what we know of the development of the Rotifera.

The first cilia which appear are motory; they are in small tufts on a circular zone on a level with the mouth; then a band of small cilia grows below the larger ones and serves to convey the nutritive particles to the mouth.

The foot has its origin in a thickening of the ectoderm, which occupies the greater part of the ventral surface of the embryo. It afterwards takes the form of a hump, and then that of a horizontal tongue, which sometimes bears an operculum on its lower side. It divides into a median lobe and two lateral ones, which become the swimming-organs.

The pallial cavity is formed by sinking-in of the ectoderm between the edge of the shell and the neck of the larva, always on the right of the anus whatever may be the position of the latter.

The larvæ of the Pteropoda have two contractile sinuses, situated the one at the foot and the other in the dorsal region, which send from one to the other the liquid contained in the cavity of the body. Neither of these sinuses can be compared to those of the embryo of the *Limaces*. The cephalic sinus of the *Limaces* corresponds to all the median portion of the velum and to the whole dorsal region of the embryos of the Pteropoda. The contractile sinus of the foot of the *Limaces* is situated at the extremity, and not at the base of the foot as in the Pteropoda.

The kidney is formed at the expense of the ectoderm, and the heart by the differentiation of a mass of cells of the mesoderm. The internal aperture of the renal canal opens outside the heart and into the pericardium when the latter is afterwards formed. The kidney beats with almost as much vivacity as the heart. The aorta and the arteries are formed by the differentiation of chains of mesodermic cells.

The walls of the stomach are differentiated into two layers—an external one of muscular fibres, and an internal mucous layer; this latter produces five horny teeth, preceded sometimes by the appearance of a single larval plate. The vitelline sacs, of which there are two at first, unite into one in the Orthoconcha. This sac, which opens into the dorsal part of the stomach, is absorbed and diminishes rapidly in the Hyaleaceæ; on the contrary, it is developed in the Styliolaceæ and the Creseideæ, where it seems to play, provisionally, the part of the liver. In every case it diminishes in proportion as the liver is developed. The liver is composed of small diverticula of the wall of the stomach. The nutritive sacs have nothing to do with the formation of this organ.

The otocysts are formed early, in the midst of a layer produced by a doubling of the ectoderm still composed of large embryonic cells. The otolith originates in the thickness of the wall of the vesicle, and falls afterwards into its cavity. In the *Limaces* and the *Cephalopoda* the otocyst is formed by an invagination of the ectoderm already composed of very small cylindrical cells. The size of the embryonic cells of the generative layer seems to be in this case, as in many others, the cause which determines the mode of formation of an organ by invagination or by simple folding.

The nervous system is composed of a cephalic nervous mass and of a subœsophageal mass. The former is formed by a double invagination of the ectoderm of the cephalic region in the area circumscribed by the velum; the mode of formation of the second has not been observed in the Pteropoda.

The appearance of the shell is preceded by the formation of an invagination of the ectoderm a little in front of the aboral pole. This preconchylian invagination turns round; and the first rudiment of the shell appears on the projection thus formed. In exceptional or abnormal cases this invagination does not turn round, or rather it is reformed after having disappeared. Its existence is incompatible with that of an external shell and *vice versa*. It is the point of departure of the band which secretes the shell ring by ring, and which becomes the margin of the mantle. The first part of the shell, that which the larva inhabits, often differs from the portion which is added later on; it may persist, fall or break off; and it has furnished me with characters which have enabled me to subdivide the sub-order of the Thecosomatous Pteropoda. The existence of the preconchylian invagination cannot be satisfactorily explained by purely physiological causes; it seems, then, to have hereditary causes, and may morphologically be compared to the conchylian invagination of the mollusks with internal shells, which invagination I have studied in *Sepiola* and the *Limax*. The existence and signification of that invagination in the Cephalophora, the Cephalopoda, and the Lamellibranchiata have been gradually cleared up by Lereboullet, Semper, Salensky, Ray Lankester, and myself.

The sexual products originate at the expense of the endoderm. Sexuality can only be attributed to one embryonic lamella.—*Comptes Rendus*, January 18, 1875, p. 196.